

FE 515 A4

Due: Nov 12th, 2018 1:59 PM

Question 1: Exponential moving average (40 points)

Exponential moving average(EMA) is a equity indicator which can be used to determine when to buy or sell an equity. For this question, you are required to calculate EMA value for SPY.

To calculate the EMA(n) value, you need to use following equations:

$$EMA(n)_1 = \frac{1}{n} \sum_{m=1}^n Price_m$$

$$\alpha = 2/(n + 1)$$

$$EMA(n)_t = (Price_t - EMA_{t-1}) * \alpha + EMA_{t-1} \text{ where } t \geq 2$$

| | Date | Price | 10-day SMA | Smoothing Constant 2/(10 + 1) | 10-day EMA |
|----|-----------|-------|------------|----------------------------------|------------|
| 1 | 24-Mar-10 | 22.27 | | | |
| 2 | 25-Mar-10 | 22.19 | | | |
| 3 | 26-Mar-10 | 22.08 | | | |
| 4 | 29-Mar-10 | 22.17 | | | |
| 5 | 30-Mar-10 | 22.18 | | | |
| 6 | 31-Mar-10 | 22.13 | | | |
| 7 | 1-Apr-10 | 22.23 | | | |
| 8 | 5-Apr-10 | 22.43 | | | |
| 9 | 6-Apr-10 | 22.24 | | | |
| 10 | 7-Apr-10 | 22.29 | 22.22 | | 22.22 |
| 11 | 8-Apr-10 | 22.15 | 22.21 | 0.1818 | 22.21 |
| 12 | 9-Apr-10 | 22.39 | 22.23 | 0.1818 | 22.24 |
| 13 | 12-Apr-10 | 22.38 | 22.26 | 0.1818 | 22.27 |
| 14 | 13-Apr-10 | 22.61 | 22.31 | 0.1818 | 22.33 |
| 15 | 14-Apr-10 | 23.36 | 22.42 | 0.1818 | 22.52 |
| 16 | 15-Apr-10 | 24.05 | 22.61 | 0.1818 | 22.80 |
| 17 | 16-Apr-10 | 23.75 | 22.77 | 0.1818 | 22.97 |
| 18 | 19-Apr-10 | 23.83 | 22.91 | 0.1818 | 23.13 |
| 19 | 20-Apr-10 | 23.95 | 23.08 | 0.1818 | 23.28 |
| 20 | 21-Apr-10 | 23.63 | 23.21 | 0.1818 | 23.34 |
| 21 | 22-Apr-10 | 23.82 | 23.38 | 0.1818 | 23.43 |
| 22 | 23-Apr-10 | 23.87 | 23.53 | 0.1818 | 23.51 |
| 23 | 26-Apr-10 | 23.65 | 23.65 | 0.1818 | 23.54 |
| 24 | 27-Apr-10 | 23.19 | 23.71 | 0.1818 | 23.47 |
| 25 | 28-Apr-10 | 23.10 | 23.69 | 0.1818 | 23.40 |
| 26 | 29-Apr-10 | 23.33 | 23.61 | 0.1818 | 23.39 |
| 27 | 30-Apr-10 | 22.68 | 23.51 | 0.1818 | 23.26 |
| 28 | 3-May-10 | 23.10 | 23.43 | 0.1818 | 23.23 |
| 29 | 4-May-10 | 22.40 | 23.28 | 0.1818 | 23.08 |
| 30 | 5-May-10 | 22.17 | 23.13 | 0.1818 | 22.92 |

Figure 1: An example of EMA 10 calculation

In order to help you to understand this calculation, you can refer the example in Fig. 1. In this example, we set **n = 10**. Therefore, we are calculating **EMA(10)** value.

To obtain the initial value $EMA(10)_1$, you need to use first 10 days **close price** and calculate the average price. Starting from the 11th day, you can calculate $EMA(10)_2$ ($EMA(10)$ on 8-Apr-10) by using the close price (on 8-Apr-10) and $EMA(10)_1$ (on 7-Apr-10).

Meanwhile, you can use following equation to calculate Moving Average Convergence Divergence (MACD):

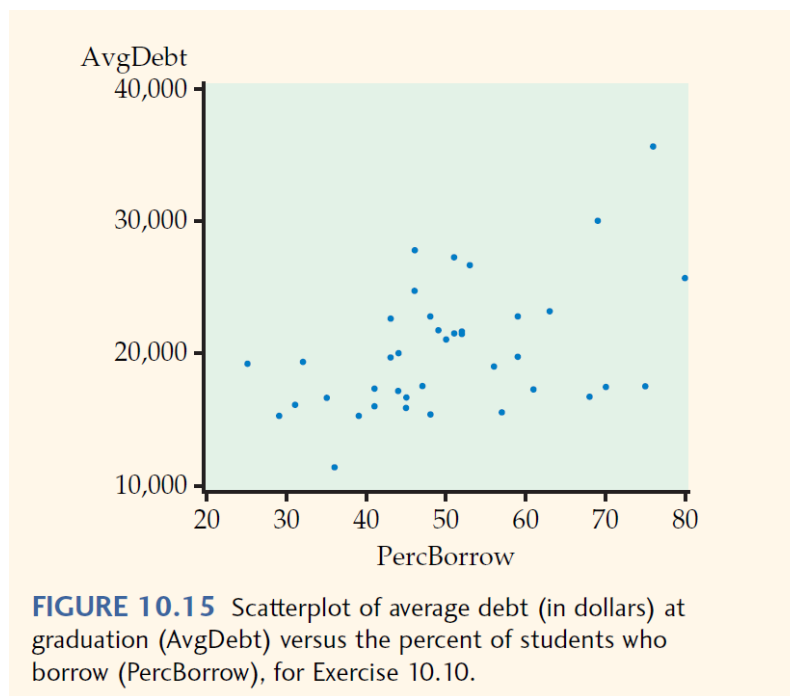
$$MACD = EMA(12) - EMA(26)$$

In this question, you need to solve following questions:

1. Calculate the $EMA(5)$ for SPY from 2017-01-01 to 2017-12-31.
2. Calculate the MACD for SPY from 2017-01-01 to 2017-12-31.
3. Using `par()` or `layout()` to generate a figure which contains two plots. The upper one shows SPY price movements and the lower one shows MACD movements. Make sure both plots has the same length of days. As usual, you need to provide X-axis label, Y-axis lable, main, legend and etc.

Question 2-1: Simple linear regression model (20 points)

Kiplinger's "Best Values in Public Colleges" provides a ranking of U.S. public colleges based on a combination of various measures of academics and affordability. We'll consider a random collection of 40 colleges from Kiplinger's 2011-2012 report and focus on the average debt in dollars at graduation ($AvgDebt$) and the percent of students who borrow ($PercBorrow$).



1. A scatterplot of these two variables is shown in Figure 10.15. Generate your linear model and show there is a linear relationship between these two variables.
2. Based on your linear model, estimate what is the average debt for a college with 10% more students who borrow?

Question 2-2: Extension (10 points)

Refer to Question 2-1. Let's now look at AvgDebt and its relationship with all seven measures available in the data set. In addition to the percent of students who borrow (PercBorrow), we have the admittance rate (Admit), the four-year graduation rate (Yr4Grad), in-state tuition after aid (InAfterAid), out-of-state tuition after aid (OutAfterAid), average aid per student (AvgAid), and the number of students per faculty member (StudPerFac).

1. Generate scatterplots of each explanatory variable and AvgDebt. Do all these relationships look linear? Which explanatory variable is the best single predictor? Create a table which summarize the performance of all your simple linear regression model and answer the questions.

Question 3: Multiple linear regression (30 points)

Refer to Question 2-1 and Question 2-2. In this question, you are going to build multiple linear regression models.

1. Design a multiple linear regression model which uses all possible explanatory variables. In this model, do you have non-significant variable? Name this model as Model 1.
2. Build a step wise regression model to the same response variable. Name this model as Model 2.
3. Compare Model 1 and Model 2. In the end, you need to tell me which model may has the best performance.

Question 4: (0 points, but if fail to answer or solve, I will deduct 10 points)

Please find 5 tickers by yourself and download 3 year length of data. For each ticker, calculate monthly return (either type). In the end, return me a table which records the monthly return for each ticker, and change the column names into ticker names.